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UNITED STATES DEPARTMENT OF AGRICULTURE
BULLETIN No. 1111

Washington, D. C. ▼ November 25, 1922

ONE-VARIETY COTTON COMMUNITIES

By

O. F. COOK, Bionomist in Charge of the Office of Crop Acclimatization and Adaptation Investigations Bureau of Plant Industry

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By O. F. Cook, *Bionomist in Charge of the Office of Crop Acclimatization and Adaptation Investigations, Bureau of Plant Industry.*[1]

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PURE COTTON SEED A FUNDAMENTAL REQUIREMENT.

To avoid mixture and degeneration of seed, only one variety of cotton should be grown in each community or district. Many other improvements may be urged, but having pure seed to plant is a basic need. Where different varieties of cotton are planted in neighboring fields and taken to the same gins, it is out of the question to keep the seed pure. The gins mix the different kinds of seed, crossing takes place in the fields, the varieties are mongrelized and cease to be uniform, the fiber deteriorates in quality, and the seed becomes unfit for planting.

[1] At the end of this bulletin references are given to previous publications in which the community features of cotton improvement have been recognized. Several paragraphs in this bulletin have been adapted from statements of the same matters in earlier papers which are no longer available for distribution.

Lack of pure seed is responsible for a general failure to utilize superior varieties of cotton and for enormous industrial and economic wastes through the production of inferior fiber and the manufacture of weak, perishable fabrics. The cotton industry absorbs the activities of millions of people, which could be applied to better advantage in raising better crops of cotton and making better goods. The producing and manufacturing operations are on a low plane of efficiency, working with raw material of needlessly inferior quality because the seed is poor. It is self-evident that the breeding of superior varieties does not result in the improvement of the cotton industry unless good seed becomes available and is used generally as the basis of production. Seed is necessary to raise cotton, and good seed must be planted if good fiber is to be obtained. The pure-seed problems must be solved, as well as the breeding problems, before superior varieties can be utilized.

Through the simple expedient of adhering to one variety in each community, the present degenerate mixed stocks could be replaced with pure seed of superior varieties. Cooperation, to the extent of agreeing to plant the same variety of cotton, is necessary if farmers are to have regular supplies of pure seed for their own use or to sell. The individual farmer, struggling alone with the idea that he can improve his crop and get a higher price in growing better fiber, is much more likely to fail than to succeed, but the prospect is altered completely when a whole community of farmers adopts and maintains an improved variety. Through community action it is possible to observe the necessary precautions, so that superior varieties can be preserved, increased, and utilized. This has been demonstrated in the striking progress made in recent years in the Salt River Valley of Arizona, where the growers have specialized on a single variety.

Considered as a means of utilizing superior varieties, community organization is as practical a need and as definitely related to the improvement of production as the invention of a new implement to cultivate the crop, a new fertilizer to stimulate the growth of the plants, or a new spray to keep off pests or diseases. Farmers and agricultural promoters would understand readily if superior varieties of cotton had to be grown on particular soils or special cultural treatment had to be given, but one-variety community organization is also to be reckoned as a condition or requirement for the production of good fiber. Though not so generally or so easily recognized by those who have been accustomed to think only of the farm operations, the community conditions may reduce or increase the profits of production as definitely as the other conditions of soil, rainfall, weevil infestation, or labor supply.

DISADVANTAGES OF MIXED-VARIETY PRODUCTION.

That so simple an expedient as the one-variety organization of cotton communities should have been overlooked so long may seem remarkable, but it should not keep us from recognizing the facts. Now that the serious defects of the present unorganized condition are recognized, more attention may be given to securing a substantial basis of progress in the cotton industry through improved and standardized production in one-variety communities. The problems of community cooperation are a field of research that needs to be cultivated at the present time for the general welfare of the cotton industry, to place production on a basis of superior varieties.

That the individual farmers of the same neighborhood should raise different kinds of cotton is as unreasonable, impracticable, and uneconomic as that each operative in a textile mill should spin a different kind of thread or weave a different kind of cloth. From the standpoint of progress in other branches of the cotton industry the lack of organization in the field of production appears as a very backward condition. The technical problems—the breeding of superior varieties, growing the crop, spinning thread, and weaving cloth by machinery—are much farther advanced than the general commercial problems of getting good cotton produced and supplied to the textile industry.

If the present system of mixed-variety production had been planned or chosen for some practical end that would need to be sacrificed in establishing one-variety communities, the case would be less clear, and an adequate discussion would require a careful balancing of the advantages to be gained against those that would be lost by communities restricting themselves to a single variety. But no argument has been developed or advantage claimed for the present condition of miscellaneous, unorganized production. The system of public gins, that destroys varieties by mixing the seed of different sorts together, has had a very gradual and unconscious development in the half century since the Civil War period.

Keeping good stocks of seed was much more feasible on the old plantations. Many of the large estates were well isolated, grew only a single variety, and had their own separate gins, so that a form of community production existed, a condition that gave place to separately operated small farms and tenant holdings and to the establishment of public gins, with the incidental result of the general mixing of seed. The changes of the farming system in the recent decades have resulted from other causes, with no relation to the need of uniform varieties or of pure-seed supplies. The pure-seed problems have had consideration only in recent years, after superior varieties had been bred and the utilization of those varieties became a practical question. It naturally was supposed that good

varieties needed only to be bred and distributed to the farmers, but experience showed that further attention must be given if varieties are to be preserved and utilized. Certainly no adequate utilization is to be expected under a system of production that mixes the varieties together, so that the work of selection is immediately undone as soon as commercial production begins.

The damage to the industry that might be charged every year to the lack of good seed and the resulting failure to utilize fully the resources of production that are applied to cotton would amount to hundreds of millions of dollars. Replacement of the present inferior mixed stocks by superior uniform varieties would give a direct gain of at least 10 per cent in quality and as much more in yield. Another 10 per cent increment might be expected from cultural improvements that are more feasible in one-variety communities, while advantages from community handling and marketing of a standardized product would not be less important than the other items, and the sale of pure seed is a further resource of one-variety communities. In returns or profits for the farmer, our present unorganized production of cotton may have only a 50 per cent efficiency as compared with what might be found possible if improved varieties and methods were regularly used in organized one-variety communities. The general waste of labor and resources of production in the eastern cotton belt contrasts painfully with the one-variety communities of the Salt River Valley of Arizona, where the Pima variety of Egyptian cotton is grown exclusively and the advantages of community organizations are beginning to be realized.

Nobody who considers the possibility of community organization of the cotton industry will doubt that the same land and labor can be made to produce more and better cotton under community conditions. From the standpoint of utilization of improved varieties and methods it becomes apparent that a faulty organization of the industry, or lack of organization, now interferes with the general application of practical results of scientific investigation. Since there is no question that production should be based on superior varieties, an expedient that would make this possible is worthy of the consideration of those who are interested in or responsible for the progress of the cotton industry. The one-variety plan seems fundamental because it is the only way that has been suggested for maintaining supplies of good seed, that are an absolute requirement for any general or well-established improvement of production. That it is difficult for communities to agree, and possible for a persistently careless or obstinate farmer to interfere with the progress of his neighbors and contaminate their seed stocks by refusing to plant a superior variety, is the most serious objection advanced thus far, but the existence of such obstacles only shows the need of more in-

formation and interest in securing community agreement if supplies of good seed are to be maintained.

If farmers had to pay a tax or license of a cent a pound in order to plant cotton of a different variety from their neighbors it is not likely that many would pay the money to indulge in their individual opinions, but they might become acutely interested in having the best variety grown so that the whole community might agree to plant this one kind and avoid paying the tax for miscellaneous planting. Unconsciously, however, cotton farmers generally are paying more than $5 a bale for operating under the present system of unorganized production, with different varieties grown on neighboring farms, if not actually on the same farm, taken to the same gin and sold indiscriminately to the same buyers.

A cent a pound, or $5 a bale, would be a very low estimate of the advantage that might be gained by community effort through the simplest precautions of planting even a medium quality of seed of one recognized variety and marketing its cotton together in even-running commercial lots, without considering the further improvement of fiber quality or the larger yields that can be had by adopting and maintaining superior varieties in place of the mixed stocks that furnish so large a proportion of the present cotton crop. The full advantage that could be expected in most places by using good varieties and other improvements that are possible under the community plan would be estimated between 5 and 10 cents a pound, with more in special cases as experience already has shown. This means that the farmers' profits may often be doubled by applying the improvements that are now definitely in sight under the community plan.

With gradual improvement of machinery, spinning of finer threads from short cotton has been accomplished, so that inferior fiber can be used for most of the textile articles that in the early days of cotton manufacture would have required much better raw material. Relatively small quantities of long, strong fiber have continued to be used for special purposes, such as sewing thread, automobile tires, and high-pressure fire hose. The special uses have increased notably in recent years with the development of the automobile industry, and the supplies would be far below the normal requirement if extensive substitution of short fiber were not practiced, even in articles that require strength and durability and should be made of good material.

On account of the present scarcity and acute demand for better cotton the manufacturing and commercial interests are recognizing the need of research for the improvement of the product, but without understanding that improved systems of production and of buying

and handling the crop are as necessary as improved varieties. The special biological problems of breeding and maintaining varieties have been solved, but not the general agronomic and economic problems of providing for the utilization of varieties. Not only the facts regarding varieties and textile qualities of different kinds of fiber need to be investigated by the manufacturers, but also the production and handling of the crop, the whole field of activity that lies between the breeding of varieties and the uses of cotton goods by the consuming public. For lack of such knowledge the manufacturers are unable to take a really practical and constructive interest in the development of the cotton industry as a whole and are unable to protect themselves against the adverse tendencies of the commercial system. Thus there is great need of closer study by manufacturers of the underlying commercial and agricultural factors that determine the production of good or poor fiber.[2]

SUPERIOR VARIETIES NOT UTILIZED.

No other plant product figures in our industrial civilization more largely than cotton, and the need of uniformity is greater with cotton than with any other crop. Fiber that is not uniform does not spin well nor make strong, durable fabrics. More labor is required to use inferior fiber, because the threads break more frequently in spinning and weaving. If the fiber is of good quality all the work of producing and manufacturing cotton is done to better advantage and the public is served with better goods. It seems not improbable that the value for textile purposes of most of the cotton grown in the United States could be at least doubled by using superior varieties, but such utilization of varieties is not possible without adequate supplies of pure seed, which are not maintained under the present system of production.

The need of improving the cotton crop is being recognized in all the principal regions of production. Experiment stations in different parts of the world are engaged in the breeding or testing of varieties of cotton and devising improved cultural methods. Each of the cotton-growing regions has its own series of diverse forms and variations to study, in addition to efforts in many countries to introduce foreign kinds and adapt them to the local conditions. Nevertheless, only a very limited application of the results of breeding investigations is to be expected, either in the United States or in other cotton-growing regions, unless the organization of the industry can be improved so that superior varieties can be utilized.

Rich possibilities of improvement have been shown in the species and varieties of cotton that have been studied intensively. Many

[2] Cook, O. F. Commercial parasitism in the cotton industry. *In* Nature, v. 105, no. 2644, p. 548–549.

superior strains have been developed, and the methods of breeding have been improved until they are far in advance of methods of utilization of varieties. But in spite of the value of good varieties being recognized, the need of special precautions for large-scale production of superior fiber has received very little consideration. Instead of select, uniform stocks being isolated and preserved by continued selection, new varieties usually are mongrelized and begin to "run out" as soon as they are planted on a commercial scale. While this mongrelizing system is followed it is impossible to keep varieties uniform or to develop large stocks of pure seed. The system of mixed-variety production has been tested on an enormous scale and for a long period of years and leaves no doubt of its adverse effects. No general or complete utilization of superior varieties seems possible under the present system of miscellaneous planting of different sorts.

Though it seemed reasonable to suppose that commercial seed firms would maintain the selection of superior stocks and meet the public demand for pure seed, dealers have the same difficulties as the farmers themselves in maintaining the production of pure seed. Most of the commercial seed is raised by farmers without special isolation of the fields and without precautions of separate ginning. Dealers have no way to get large quantities of pure seed unless they deal with one-variety communities or go into cotton farming on a large scale, in addition to conducting their business as seed merchants. To be effective for keeping seed pure the scale of farming must be large enough to provide isolation and separate ginning, or, in other words, to form a separate cotton community for producing the seed supplies of each variety handled, which for most seedsmen is out of the question.

Efforts that some of the more enterprising seed firms have made to supply themselves with high-quality seed have been abandoned, because no way was found to develop and maintain uniform stocks, even when very desirable novelties had been originated. Without doubt, reliable dealers will buy their stocks of seed from one-variety communities as soon as there is a sufficient volume of production of pure seed to meet the commercial demand. In the early stages of development of a new variety or select strain, general distribution, by sale or otherwise, is undesirable, because most of the seed that is sent out in small quantities is lost by becoming mixed with other varieties. Production of the pure seed on a practical scale is essential, whether handled later through commercial seed firms or from one community to another.

DISTRIBUTION OF NEW VARIETIES INEFFECTIVE.

When systematic cotton breeding was first undertaken by the United States Department of Agriculture, it was supposed that

superior varieties would be adopted readily, so that only small quantities of select seed would need to be distributed, which farmers or seedsmen would promptly increase for large-scale production. Several new kinds of special selections of different varieties were furnished in each distribution for several years, but the results did not justify the expectation that superior varieties would be readily and promptly utilized. It was not understood by the farmers or the seedsmen that the supplies of seed were limited to the stocks that were distributed, and no effective precautions were taken to develop or maintain large supplies of seed of the new varieties or the select strains.

Instead of serving a useful purpose, the plan of making single distributions of new kinds of seed seemed only to be adding to the general mixture of sorts. Further experience showed that even repeated distributions of seed in small quantities, of even the most desirable new kinds, did not result in the varieties becoming established in cultivation. Many farmers sent very favorable reports on the behavior of the new varieties, but only a few saved the seed separately, and very few cases were found, either among farmers or professional seedsmen, who on their own account maintained the isolation of the fields and separate ginning of seed long enough to reach the stage of commercial production.

Thus, the method of distribution that was first projected did not result in establishing commercial supplies of pure seed. Several of the varieties that were developed and distributed in the early years of the cotton-breeding work were lost completely before the system of distribution was changed. The difficulty and uncertainty of securing these fundamental precautions, even among farmers who had active interest and were in voluntary cooperation with the Department of Agriculture, led finally to a clear recognition of the need of establishing one-variety communities. No other way has been suggested for maintaining and increasing stocks of pure seed on a scale that would provide for the general utilization of superior varieties. Further study and experience with one-variety communities have only confirmed and added to the reasons that were given in the first statement of the plan, published in 1911.

To avoid some of the defects of the plan that had been followed for several years, a change in the method of conducting the distribution of cotton seed was recommended and adopted in 1913. Smaller packages of seed, a quart instead of a peck, were used for the general distribution, but supplemented in the following year by a special distribution of half-bushel lots to a select number of farmers located in the most favorable districts for the particular varieties, as shown by reports furnished, supported by actual samples of bolls showing

the normal behavior of the variety on their farms. Such applicants were supplied with half bushels of pure seed, enough to plant an acre of the new variety and raise a bale of cotton if conditions were favorable. On this basis the chances of establishing a stock of the new variety and of taking the precautions of separate ginning and isolating the fields were distinctly better than when a beginning had to be made with a peck of seed. Since that quantity was too small to grow a separate bale of cotton, many farmers did not use the seed, or they planted and picked it with other cotton, thus adding to the general mixture of sorts.

Under the improved plan of distribution, information was sent out with the seed, explaining the need of isolation, separate ginning, and the "roguing out" of abnormal variations, so that the stocks might be kept pure and new centers of seed supply established. Not only was waste of seed avoided by the new plan, but interest was stimulated by the prospect of securing a practical quantity of seed. Many cases have been reported where the precautions were observed and new centers of production of superior varieties established through the special distribution of the half-bushel lots of seed. In other cases the local interest in the new varieties resulted in the purchase of larger stocks of seed, enough to plant 5 acres or more, in order to save time or as a means of avoiding the contamination that already had taken place in the smaller stocks of seed. Thus, it appears that 5 bushels of seed, rather than a peck or a half bushel, should be considered as the practical minimum if there is a serious intention to adopt a new variety and maintain a pure stock.

That so little good seed of really select, uniform stocks is to be had at any price is the most serious obstacle in extending the cultivation of a new variety. To secure the production of larger amounts of seed, so that it is possible for those who become interested in a variety to purchase pure seed in practical quantities, is more important in establishing a variety than the general distribution of small quantities of seed. Cooperation with communities rather than with individual farmers has accordingly been recognized as an essential feature in developing seed supplies, so that new varieties can be more widely utilized.

Instead of dividing and distributing small stocks of pure seed, the first need is to centralize the production of a new variety in a few localities where it is possible to secure interest and unanimity of action among the farmers, to the end of increasing the seed stocks until centers of production are established and supplies are available for other districts. Until this stage is reached it is a waste of good seed to distribute or sell it in small quantities to farmers who will not grow it in isolated fields and provide separate ginning.

Except for bringing new varieties to the attention of farmers so that the behavior of the plants can be observed under the local conditions, no purpose seems to be served by the distribution of seed in small quantities.

Cooperation with organized communities to establish new centers of seed supply apparently is the only practical way of extending and establishing the utilization of superior varieties. Keeping small lots of seed separate in mixed-variety communities is more expensive of time and money than buying practical quantities of seed. The individual seed stocks are generally precarious and can be lost in many ways, through accident or carelessness. After several years of precaution and careful selection work in cooperation with the Department of Agriculture, a farmer in the Imperial Valley of California had his select stock of Durango cotton destroyed by a mistake at the gin, his carload of select seed being run into the common seed pile while a carload of ordinary seed was kept separate. Many such incidents could be recounted to illustrate the numberless ways of getting seed mixed, even when an effort is being made to preserve pure stocks, under mixed-variety conditions. Several other cases that also occurred in the Imperial Valley several years ago, in connection with the same variety of cotton, may be recounted.

Clean Durango seed, purchased at fancy prices, has been planted on land where short-staple cotton was grown in the previous season, thus insuring mixture of seed and cross-pollination from the volunteer short-staple plants. In one case a farmer who had been cautioned against planting his new pure seed on land where Egyptian cotton had previously been grown, afterwards planted the seed on land which had been in short staple. This shows that the object of the precaution was completely misunderstood, for if new land could not be had it would have been much better to plant the Durango where the Egyptian cotton had been. Egyptian volunteer plants could have been detected and removed much more easily than the short-staple Upland volunteers.

Several lots of Durango seed were brought in from Texas, and came from as many different planters. Some lots were known to have been carefully grown and ginned separately to avoid mixing with seed of other varieties, but other lots were not known to have received similar care. Special care had been urged in handling these different lots in order to keep the seed that was known to be clean separate from the other lots. In spite of repeated cautioning, the identity of the clean seed was made uncertain by failure to mark the bags or to keep them separate. The different lots were piled in the same warehouse and some of the piles fell down.

In one instance, at least, seed of another variety had been distributed as Durango on the careless assumption that all kinds of long-staple cotton were much the same, so that a substitution would be only a mild form of deception. The seed used in this instance to replace Durango was of an inferior mixed stock and would give a very misleading idea of the variety.

Unmixed Durango cotton raised in the Imperial Valley was sent to the public gin and the seed allowed to pass through the conveyors which had been used with short-staple cotton and contained a quantity of the short-staple seed.

An appreciable mixture with the short-staple cotton, in some fields from 4 to 6 per cent, occurred in this manner.

Admixture of Durango cotton with Egyptian also resulted from putting Durango seed into sacks in which Egyptian seed cotton had been carried to the gins. Fields planted with this seed showed a scattering of Egyptian plants among the Durango. The changing of sacks without proper care in cleaning them, it would seem, might be a very common cause of mixture.

The purity of another carefully guarded field of Durango cotton was jeopardized by the carelessness of a neighbor who had left some short-staple seed by the roadside. In preparing the land for the Durango cotton some of the short-staple seed was dragged into the field. The owner knew nothing of this until the scattering short-staple plants were noticed in one corner of the field, and then the origin of the contamination was traced. In this case immediate attention was given to the removal of the short-staple plants, which were easily distinguished from the Durango.

A final instance is that of a farmer who took pains to secure a good stock of Durango seed for planting his field, but he did not secure a complete stand, so replanted with Triumph short-staple cotton to fill the vacant places.

As a result of such accidents and oversights a large proportion of the fields are more or less contaminated.[3]

Keeping seed pure under conditions of constant danger of mixing is not only a difficult undertaking, but so precarious that only the most progressive and persistent farmers are likely to continue their efforts beyond a few seasons. With a background of such incidents it is almost needless to say that the Durango seed stocks were not maintained in the Imperial Valley, since the effort did not result in establishing one-variety conditions of production in any locality. Egyptian cotton, Durango cotton, and short-staple cotton are still grown, but of inferior quality, as the seed stocks are contaminated.

DETERIORATION THROUGH PUBLIC GINS.

The public-gin system, which gives each farmer an admixture of his neighbors' seed, is largely responsible for bringing the cotton industry to the present condition, that cattle or other live stock might reach if the pastures were not fenced or if all the herds were run together in the breeding season. Needless to say, there would be no pure breeds of cattle under such a system, and it is equally out of the question to maintain pure varieties of cotton while different kinds are planted in the same districts, mixed together at the gins, and cross-pollinated in the fields. In spite of breeding better varieties and efforts to increase the seed supplies, the good stocks still represent only an infinitesimal part of the volume of production. Millions of bales of needlessly inferior cotton are produced every year from seed that should have gone to the oil mills instead of being planted.

[3] Cook, O. F. The relation of cotton buying to cotton growing. U. S. Dept. Agr. Bul. 60, 21 p. 1914.

Improvement of varieties was more feasible under the old system of private gins, because the careful planter could maintain uniform strains of cotton by selecting the best individual plants, isolating their progenies, keeping the seed separate, and furnishing pure seed to stock other plantations, as the custom was. With selection practiced and superior stocks isolated, the old plantations had the advantages of one-variety communities, while under the public-gin system varieties are mongrelized and destroyed, even before they can be established widely in cultivation.

The cotton industry should have been placed on a community basis when public gins supplanted the former system of private or plantation gins after the Civil War, but methods changed gradually and consequences were not considered. Mechanical improvements and economic advantages were reckoned, but not the effect upon seed supplies. Ginning is done with less labor by the modern high-power equipment, but the public-gin system has made it very difficult to keep seed pure or to have superior varieties in general cultivation.

According to the general testimony of the cotton trade there has been a serious deterioration in the quality of the American cotton crop in the half century since the Civil War period, and this can be understood when account is taken of the effects of mixing and crossing different varieties and the general use of ordinary "gin-run" seed for planting. The system of plantation gins survived longer in the Sea Island districts of the Southeastern States and in the Mississippi Valley, where long-staple Upland varieties were grown, so that the long-staple branches of the industry remained on a somewhat better footing until recent years. But with the boll-weevil invasion the dominance of the public-gin system and of mixed short-staple varieties became complete.

Everybody who knows the construction of cotton gins is aware that the mixing of seed must take place between successive lots that pass through. The gin construction is such that all the seed does not pass out of the machinery when the ginning of a bale is completed. If the machinery is not thoroughly cleaned, which requires time and effort and very seldom is done, some of the seed from one lot of cotton is held over and passes into the next lot, so that the seed stock is contaminated if the two lots represent different varieties. Though the fact of gin mixing could not be doubted, the nature and extent of the process were not definitely known until 1915, when a method of demonstration was devised by Dr. D. A. Saunders, at that time in charge of the cotton-breeding station of the United States Department of Agriculture, at Greenville, Tex. The expedient used by Doctor Saunders was to color the seeds that were left behind in the gin after a bale had been finished in the usual manner. After the seeds had been dyed red and were thoroughly dry they were put back

in the gin in order that their behavior in the subsequent working of the gin might be observed.

Contrary to the general opinion of practical ginners that all of the left-over seed would come out with the first few bushels of the next "run," or at least with the seed of the first bale, it was found that colored seeds continued to appear, in gradually decreasing numbers at the end of 5, 10, 20, and even 30 minutes, or during the whole period of ginning of the first bale, and that a few colored seeds still remained in the gin and came out with the seed of the second bale.[4]

A second report covering the same general ground, but describing an experiment with more recent types of gin machinery and ginhouse equipment, published recently shows that mixing at present is even more extensive than a few years ago, as a result of the use of larger and more numerous gin stands, with many pneumatic and screw conveyors in modern gin plants. As much as 60 pounds of seed may remain behind in the "seed roll" of a modern 80-saw gin stand, and since four or more gin stands usually are employed together, the volume of seed mixture tends to increase rapidly. The experiment showed that more than 25 per cent of mixture in the seed of the first bale, following a different kind of cotton, is to be expected with modern gin equipment. Moreover, since the time of ginning a bale of cotton is reduced by using the larger and more numerous gin stands, the range of mixing is widened. Thus, in a recent experiment, with machinery that ginned a bale of cotton in 13 minutes, the colored seeds continued to appear not only during the ginning of the second bale, but a few were left for the third bale. When it is considered that farmers usually bring only one or two bales of cotton to the gin at the same time, the results of this experiment are practically fatal to the idea of getting any unmixed seed from a public gin unless special precautions are taken to clean the gin stands and to keep the seed from going through the conveyors. Shutting off the conveyors and sacking the seed under the gins are an absolute requirement. This experiment showed that contamination continues even to the fourth bale and beyond when seed is not sacked under the gin, but allowed to go through a screw conveyor.[5]

GIN-UNIT COMMUNITIES.

Cotton is a community crop. The nature of the cotton gin, the machine that separates the fiber from the seed, form all the farmers who send their cotton to the same gin into a community

[4] Saunders, D. A., and Cardon, P. V. Custom ginning as a factor in cottonseed deterioration. U. S. Dept. Agr. Bul. 288, 8 p., 5 fig. 1915.

[5] Ballard, W. W., and Doyle, C. B. Cotton-seed mixing increased by modern gin equipment. U. S. Dept. Agr. Dept. Circ. 205, 12 p., 1 pl. 1922.

with mutual relations, whether recognized or not. The ginning establishment and the surrounding farmers who grow the cotton represent two parts of a local system of production. The farmers are dependent upon the gin, not only for separating the lint from the seed, and thus completing the harvest of the crop, and for packing the product in bales, so that it can be sent to market, but also with respect to future crops, for the seed as well as the lint goes through the gin machinery, so that the seed supply is affected.

Cotton gins are like grist mills in having no provision for keeping any farmer's seed separate. A modern gin equipment gives each farmer several bushels of the mixed seed held over in the gin rolls from the previous customer's seed, most of it worked out gradually into the seed of the next customer. In this way a general community mixture is formed if the tendency is not overcome. The larger the development of ginning machinery to work more economically and efficiently, the wider the community seed relation becomes. The community, therefore, must decide whether one good variety is to be grown or a degenerating mixture of varieties.

The industry as a whole is made up of gin-unit communities, each with its ginning establishment as the center or focal point of community interest and activity, like the nucleus of a cell in a plant or animal tissue. But a biological analogy for the general structure of the cotton industry is not complete, because the relation of the gins to the surrounding communities is not wholly beneficial or constructive. The ginning and baling are done, but as long as gins are responsible for the mixture and deterioration of varieties there is a drawback, a negative, injurious effect on production. Once this is clearly recognized the injury can be avoided by organizing one-variety communities. The public gin ceases to be a menace or agency of deterioration when the cotton is all of one kind.

It is conceivable that the mixing of seed at gins could be avoided by devising and installing new types of gin machinery and ginhouse equipment that would keep each farmer's seed separate. Such mechanical improvements would be possible and certainly would be desirable, even at a cost of hundreds of millions of dollars, if there were no better way to have the industry supplied with good seed. But there is a simpler and more effective way that can be followed in any progressive community by the farmers uniting upon the planting of a single superior variety. No extra cost is involved in the plan of one-variety communities, and the crossing of varieties in adjacent fields by bees or other insects is avoided as well as the mixing of seed at the gin, so that a progressive course is open toward a general utilization of superior varieties, in complete contrast with the present system.

Since the cotton must be compressed into bales by machinery as well as ginned, the costs of machinery, power, equipment, and installation of a modern ginning plant are beyond the resources of the average farmer and can not be provided economically for any small acreage of cotton. Less than a thousand acres is hardly to be considered as a community for even a small ginning plant, costing from $5,000 to $10,000. Plants costing from $20,000 to $50,000 are considered more economical and serve large centers of production, where many thousands of bales are ginned every year.

That the farmers themselves and those who are concerned with the progress of agriculture have not been accustomed in the past to think of the cotton industry in terms of community relations with the gins only shows how far the seed-supply problems and other scientific applications in the field of production have been neglected. But with these relations once clearly recognized, practical reforms may be expected to go forward rapidly, in view of the many agencies of agricultural improvement that now exist in the United States, including local, State, and National organizations that are devoted to agricultural progress.

TOO MANY COTTON VARIETIES.

Hundreds of different varieties of cotton or names for cotton varieties are current in the Southern States, vastly in excess of any practical need. Many of the older varieties, and especially the late-maturing kinds, have disappeared in the last decade, during the period of the boll-weevil invasion. But many new varieties, or at least new names, are brought out every year, advertised as valuable novelties, and distributed as widely as possible, only to add to the general mixture of sorts.

The need of varieties being adapted to local conditions is to be recognized, as well as the need of different kinds of fiber for textile purposes, but there are no practical reasons to justify the existence of any large number of varieties. A dozen good varieties would be very much better than hundreds. Some varieties require rather special conditions, but others can be grown over large regions. The new early-maturing varieties that have been introduced from Mexico to meet boll-weevil conditions have been grown successfully in widely different regions, not only in experimental plantings but on a commercial scale. The Durango cotton, a new Upland type introduced a few years ago from Mexico and first acclimatized in Texas, has shown its ability to produce large crops of good fiber over almost the entire range of cotton cultivation in the United States, from southern Virginia around Norfolk to the Imperial Valley in California. The Acala cotton, more recently acclimatized from southern

Mexico, is even more hardy and resistant to extremes of dry weather or short-season conditions. The wide range of adaptation is important as showing that production may be standardized on the basis of a few important commercial types with locally selected strains.

On the other hand, it has not proved practicable to transfer the Egyptian cotton from Arizona to the eastern cotton belt, or even to Texas, or to establish the Mississippi Valley "Peeler" or "Delta" varieties of long-staple Upland cotton in the Southwestern States. The Egyptian cotton finds favorable conditions in the irrigated valleys of Arizona and California, while in Texas and farther east it is much more susceptible than Upland cotton to the black-arm disease. On the other hand, the Upland cottons when planted in the southwestern valleys suffer worse than the Egyptian type from the blasting and shedding of buds and young bolls. Moreover, the short-staple Upland varieties from the Southeastern States are more affected by extreme conditions in Texas, Arizona, and California than are the Texas big-boll varieties. As a result of repeated comparisons in many localities for more than a decade, greater resistance to drought or other unfavorable conditions may be claimed for the Upland varieties that have come from Mexico and Central America, which seem likely to displace the eastern short-staple varieties.

In view of the wide availability of better varieties, no agricultural reasons can be alleged for continuing to produce in the United States cotton of less than an inch staple, nor do there appear to be any industrial or general economic reasons for holding to the short and inferior fiber that still forms a large proportion of the American cotton crop. Not only resources and labor of production are wasted in being applied to inferior varieties and mongrel seed stocks, but enormous industrial and economic wastes are involved in the manufacture and use of weaker and less durable fabrics.

A widely different policy needs to be established in relation to cotton varieties to give production the best footing. Any variety that is to be used properly and effectively must be kept by itself instead of being mixed and mongrelized by crossing with other kinds, since it is out of the question that high-quality production should be based on the use of several varieties together in the same communities. Frequent change of varieties is also inconsistent with the true interests of the producers. Full market recognition of the superior quality of any local product is not to be expected until time has elapsed, to allow the article to become appreciated and a reputation established. Obviously, it is impossible for any cotton-growing community or district to gain such recognition if varieties are changed frequently. As far as possible, the practical interest of each community should remain focused on a single variety and changes made only

when definite advantages have been shown and seed supplies are available, so that all neighboring farmers may change together to the new variety.

RENAMING VARIETIES OF COTTON.

The practice of renaming varieties is one of the obstacles in the way of a more general understanding and application of the one-variety plan, as tending to conceal or obscure the fact that the same variety of cotton can be maintained and utilized in the same community for many years with no deterioration or "running out" if isolation and selection are maintained.

No doubt the renaming of varieties is, at least in part, a concession to the popular idea that new kinds are needed every few years. Knowing that this idea is prevalent, the dealers suppose that more seed can be sold under new names than by continuing to offer old and well-known varieties. With the public better informed regarding the value of good varieties and the need of maintaining supplies of pure seed, the policy of renaming varieties may be altered. Farmers who are sufficiently intelligent to buy good seed in practical quantities prefer to know what they are buying, whether it is a variety already known or a new and different sort. They do not wish to buy even good seed under a new or unnecessary name.

Special quality of seed is properly to be claimed if careful selection of the basic stocks is continued and the seed-increase fields are inspected to see that the plants are uniform and to remove the off-type individuals that continue to appear even in the best stocks. But the use of precautions to keep a variety pure is not a reason for changing the name. Discarding the original name tends rather to confuse the public and to restrict the use of the variety instead of securing a wider appreciation of its value. In view of the general scarcity and active demand for good seed of such varieties as Columbia and Lone Star, it is difficult to believe that anything was gained by advertising some of the seed stocks under new names, like "Webber" or "Bennett." The Foster variety, also originated and distributed by the United States Department of Agriculture, was exploited for several years in Mississippi and in the Imperial Valley of California as "Unknown." At Yuma, Ariz., in 1919, a stock of Durango seed was sold as "Rowden" to settlers from Texas who were anxious to grow the true Rowden cotton, a big-boll sort that is very popular in some of the sandy land districts of Texas. But the so-called "Rowden" of the Yuma Valley attracted further attention by yielding a premium staple, and now a "California Improved Rowden" is being advertised in Texas as a new and valuable long-staple Upland variety.

Possibly it might be argued in such cases that varieties bred and distributed by the United States Department of Agriculture are considered as public property and that the new names are required for proprietary advertising purposes, so that higher prices can be charged in accordance with the general custom of seedsmen to regale their customers with high-priced novelties every year. But if prices were not so high the volume of business might be larger if really good seed of tested and recognized varieties was known to be available. The present policy leaves out of account the fact that any variety, no matter how it was originated, needs to become widely and favorably known before there can be any very large or regular demand for the seed. The legitimate advertising value of the fact that a variety was originated and distributed by the United States Department of Agriculture after being tested carefully in many localities is now recognized by some of the seedsmen. However, the practice of renaming varieties is by no means confined to those originated by the Department of Agriculture. Large numbers of cases were recorded in Bulletin No. 163 of the Bureau of Plant Industry, entitled "Varieties of American Upland Cotton," published in 1910.

Even when no attempt is made to conceal the fact that a new name represents only a special stock of a well-known sort, the change of name still carries an idea that some definite difference exists or is claimed. It is to be recognized, of course, that definite variations may be found in any variety, plants that are distinct from the parent stock, and that new names are required if these distinct forms are separated, bred into varieties, and placed in cultivation. But it is a mistake to suppose that novelties are of value as such or that frequent and indiscriminate introductions of new kinds are desirable. When a really new variety is to be established in cultivation, many experiments are needed in different parts of the country to determine the cultural characters and adaptations of the new sort, as well as the textile quality of the fiber. From the practical standpoint the claim of novelty is not to be made lightly, since in many practical ways it is a handicap to a variety to be new and untried. A period of years is required before the handicap can be removed by the practical experience of growers and a regular demand established with a basis of intrinsic value instead of mere advertising claims.

Though it doubtless is better to sell good seed under a new name than to send out an inferior stock merely to have something new to advertise, really good seed of a well-known variety should be considered more valuable than any new and untried sort. As soon as the possibilities of preserving and utilizing varieties are understood, the demand for uniform well-selected stocks of seed of established varieties undoubtedly will be greater than for new kinds of cotton.

Organized communities will not change varieties until definite advantages have been shown to justify a change by the whole community instead of by individual farmers. Intelligent communities will very properly avoid any new variety that does not come from a responsible source, well authenticated and with a definitely determined commercial status. The danger to the industry and loss to the farming public that result from introducing inferior varieties, or even too many good varieties, are being recognized in Egypt, in a proposal that has been made to license the introduction of new varieties and thus keep irresponsible parties from distributing undesirable sorts.

COMMUNITY PURE SEED THE BEST.

With one variety properly isolated and selected under local conditions, the seed not only can be kept pure and uniform but is likely to give better results than any seed that can be obtained from other districts. The degeneration that results from the crossing of different varieties no doubt is the basis of the popular idea that cotton varieties soon "run out" and that "fresh seed" must be brought from other districts. Though selection must be maintained to preserve a high degree of uniformity in any stock, deterioration is much more rapid if crossing takes place. The progenies of hybrid plants show large numbers of inferior individuals that are the most conspicuous evidence of degeneration. In this sense varieties undoubtedly "run out" with rapidity, depending on the extent of crossing that takes place.

The well-known fact that some of the best and most popular varieties have been grown for many years in the same place should be sufficient in itself to discredit the idea that degeneration of varieties is inevitable or to be expected in a few seasons. The well-known "Triumph" cotton, bred by Mr. Alexander Mebane, of Lockhart, Tex., has been maintained for 28 years by continued selection of the same stock, as stated personally by Mr. Mebane at a meeting of South Texas cotton growers at Corpus Christi on October 16, 1920.

Yet the superstition of "changing the seed" is widely current in the cotton industry and continues to be propagated by seed dealers as well as by owners or managers of gins and oil mills, who often sell carloads of "fresh seed" to the farmers of the surrounding community, regardless of the fact that bringing more kinds of seed into the community only widens the range of mixing that goes on at the gins and the crossing in the fields. No matter how good the "new" seed may be, there is no hope of retaining the uniformity of any select stocks that may be added to the general mixture. The only prospect of having a good variety to use is by united community

action for cleaning out the mixed seed and then maintaining a pure stock. As long as isolation is maintained the varieties are preserved with no evidence of "running out" that has anywhere been established on a basis of scientific credence. The districts that produce the good seed do not change their varieties, but continue to furnish the same seed for those who believe that "seed must be changed."

The idea formerly entertained that cotton is not cross-pollinated or that crossing is very infrequent and not of practical importance in relation to seed supplies has proved to be erroneous. Although cotton pollen is not blown about by the winds, because the grains are sticky and adherent, the pollen is carried commonly for considerable distances by bees or other insects that visit the flowers, so that varieties growing in neighboring fields are cross-pollinated, in addition to the general crossing that takes place in fields where mixed seed is planted.

Apart from the results of mixing and crossing, no real basis of natural law, reason, or necessity for the supposed rapid deterioration of seed or for the shipping of seed about from one district to another has been demonstrated in connection with cotton. After long periods of years it may be that varieties will deteriorate, decline in fertility, or become more susceptible to disease in spite of careful selection being applied, but at least it has to be recognized that such eventual deterioration, if the fact were established, would be quite distinct from the "running out" through the crossing and mongrelizing of different sorts that are grown and mixed together.

Mongrelizing is a result of careless handling of varieties instead of being a defect or a disease. The supposed remedy, "changing the seed," does not remove the cause of degeneration, but only invites more "running out." The more numerous the varieties represented in a community, the greater the mixing of the seed at gins and crossing in the fields. Instead of "change of seed," the methods of obtaining the seed supply need to be changed, so that varieties can be preserved and kept uniform instead of being mixed and allowed to deteriorate. No matter how good the original varieties may have been, a mixed stock becomes, in a few generations, thoroughly miscellaneous and mongrelized, with many abnormal and infertile plants, very inferior to the parental types.

Once the belief in rapid "running out of varieties" is abandoned, the supposed need of a continual succession of new varieties may give place to a stable system of production, with no casual changing or mixing of varieties. A variety that is once established in cultivation should continue in use until a better is definitely known and adequate supplies of pure seed are provided in advance, so that whole communities at once may secure a new basis of production.

Stabilized community production of the best variety that can be grown under the local conditions is the ideal that should not be sacrificed to curiosity or casual interest in untried novelties, even though vividly advertised. Testing new sorts is important, of course, so that no really valuable improvements may be overlooked, but not many farmers can observe the precautions that are necessary to secure definite determinations of relative values of varieties. Even the agricultural experiment stations find this a difficult problem, requiring several years to reach reliable results. Seed from test plantings is worthless, on account of the crossing that usually takes place, so that the experimental farmers often injure their own crops. When the real issues are understood, a farmer who plants an unknown variety of cotton will be considered as erratic as one who would raise a dangerous weed in his garden or try casual experiments with foreign pests or diseases.

To begin a new community, the best seed that is obtainable should be brought in from some district where selection and isolation have been maintained to guard the purity and uniformity of the stock. With the same precautions continued for a few years under the local conditions, the home-grown seed is likely to be found distinctly better than any that can be had from other districts. A special value is indicated for selection under local conditions in giving a better adjustment or more uniform expression of the desirable characters of a variety, in contrast with the greater variability that often is shown in stocks that are planted for the first time under new conditions. Experiments show that selection for local adjustment is needed to render the varieties more fully adapted to the local conditions, as indicated by the fact that larger yields have been secured from locally selected strains than from seed of the same varieties brought from other districts in cases where careful comparisons are made. Further examples of local adjustment have been published recently from experiments in North Carolina and Mississippi.[6]

DIFFERENT KINDS OF ORGANIZATION.

Many different forms of organization may be expected to develop to serve various local needs under the general purpose of community improvement of cotton production. Large properties that have their own gins and handle their seed stocks carefully may establish one-variety community conditions by adopting this as a principle of management, or neighboring estates may adopt such a policy and make it effective through ownership or control of a

[6] Brown, H. B. Why not plant home-grown sotton seed? *In* Prog. Farmer (Miss. Valley ed.), v. 36, no. 14, p. 391. 1921.

gin. Formal organization may be unnecessary if agreement can be made effective in other ways.

The problems of marketing have become acute in recent years and have the public attention as never before, but this interest should not detract from the importance of improving production, which gives a better basis for improvement than any other feature of the industry. For marketing reasons alone it might be urged that communities should grow only one variety, because better prices can be secured for large quantities of one kind of fiber than for small quantities of different kinds, but other reasons for community cooperation lie strictly in the field of production. Some economists treat marketing as a community problem, in contrast with production as an individual problem, but this distinction is hardly to be maintained in the cotton industry. Certainly there are market advantages to gain through community organization, quite apart from any effort to improve the crop, but the community factors of production are equally distinct and should not be confused in practical thinking. Organization for the improvement of production may serve important purposes and yet be kept entirely distinct from marketing organizations.

Community production does not mean that the individual farmers are any less responsible for the careful handling of their crops, but the underlying conditions of production are improved. With better varieties grown and better methods used, better results can be secured from all the farm operations, as well as in the marketing of the cotton at the end of the season.

Planting only one kind of cotton in a community is a very simple and practicable improvement that benefits all the farmers and all the business men of an organized community and injures nobody. As soon as pure seed is available for the entire community, production advances to a higher plane. The only serious obstacle that interferes with a rapid extension of this elementary improvement is that the facts are not known widely and intimately enough. The farmers themselves, and even the leaders of agricultural progress, are not sufficiently aware of the practical importance of good varieties of cotton, nor of the precautions of isolation, separate ginning, and continued selection that are needed to maintain the purity and uniformity of the stocks. Many progressive farmers would be ready to take these precautions if they could be assured that practical advantages would be gained, and such assurances become possible when one-variety conditions are established.

Advantages of community cooperation in the marketing and through bringing together larger quantities of cotton are being demonstrated by the Bureau of Agricultural Economics. Cooperative marketing communities have been organized in several States,

and assistance is given by the bureau mentioned in grading and classing the cotton, to furnish a basis for more direct dealing in large lots with responsible local buyers or with outside purchasers. This tends to stimulate competition, and it has been shown that buyers will come from long distances if sufficiently large stocks of cotton are offered. Moreover, the chance of securing a large lot of one superior kind of cotton is more of an attraction to an outside buyer than the same number of bales made up of different varieties or raised from mixed "gin-run" seed. The following statement, published in the News Letter of the Department of Agriculture for August 10, 1921, gives an example of the results that have been secured in some localities by cooperative cotton marketing:

Texas Growers Benefit Through Pooling Cotton.

How demonstration work in cooperative marketing is aiding farmers during the current season is illustrated by the story of a pool formed in Texas, as reported by the Bureau of Markets and Crop Estimates of the United States Department of Agriculture.

Three hundred bales of cotton were placed in this pool. Individually the growers had been offered from 3 to 7 cents a pound for the cotton on their local market. The entire lot was classed by representatives of the Federal bureau and grade cards issued to the owners. The samples were then forwarded to Dallas and the cotton trade invited to bid. The lot was sold at 10.25 cents a pound average.

On the classification made by the bureau's representative the pool averaged 75 points off middling. The middling spot price at Dallas on the day of the sale was 10.35 cents. The growers' accounts were settled on the basis of the grade cards issued for the individual bales, using the Dallas differences for the day.

In unorganized communities the farmers who raise better cotton than their neighbors usually are forced to sell at the same price to the local buyers. Manufacturers pay more for high-quality fiber, but the difference is absorbed by the buying trade instead of being shared with the farmers. The more valuable bales contribute to the profit of buying and sorting over the miscellaneous "hog-round lots" accumulated by local buyers, many of whom do not know how to "class" the cotton. Where this condition exists, so that farmers have to sell their cotton at the same price without regard to the quality of the staple, the only object in choosing varieties is to get large yields. Some of the most inferior varieties, with short, weak, and irregular lint, yield well and are grown in large quantities simply because the commercial system fails to apply any adequate discrimination of quality in buying the cotton from the farmers.

Failure to give the farmer practical encouragement in his effort to improve the crop is a serious defect of the present commercial system, but organized communities have a standardized product, better than any of the "even-running lots" that can be made by sorting and

matching the inferior fiber of mixed communities, so that the commercial problems are simplified. Even in advance of formal organization of communities a distinct advantage may be shown as the one-variety condition is approached. The general popularity of the big-boll type of cotton in Texas has kept the crop more uniform and given that State an appreciable market advantage in comparison with other parts of the Cotton Belt. Premiums of $10 to $20 a bale are being paid in Texas and Oklahoma communities because most of the farmers grow the Lone Star or Acala variety and the buyers compete for the superior fiber. Active campaigns for community standardization and marketing are in progress in Texas, Oklahoma, and North Carolina.

PROGRESS IN ORGANIZED COMMUNITIES.

One-variety communities are progressive in many ways that are beyond the possibilities of unorganized communities. With only one variety being grown, interest and emulation develop among the farmers, because they know that their results will come into direct comparison with those of their neighbors and will depend very largely on their ability to handle their crop in a skillful manner. Effects of different conditions of soils, seasons, and cultural methods are more clearly recognized in one-variety communities instead of being confused with differences in the characters of the varieties, and the farmers gain a more thorough, practical familiarity with the characteristics and behavior of the single type to which their attention is devoted.

No other cotton-growing district has made such rapid progress in recent years as the Salt River Valley of Arizona, where only the Pima variety is grown. The interest in the Pima cotton has been more acute and more constructive than would be possible if attention were divided upon two or more sorts. Cotton problems are discussed with interest and profit at farmers' meetings, because everybody is having experience with the same variety. Such progress is not possible in communities where different kinds of cotton are grown and farmers are accustomed to ascribe their success or failure to the seed that was planted.

With adequate understanding of the behavior of one variety, methods are adjusted more closely to differences of soils, seasons, and times of planting, and labor is applied to the best advantage in farm operations. In weevil-infested regions it is especially important that all the farmers of a community grow the same variety, plant as nearly as possible at the same time, handle the crop together, and clear the fields early in the fall. One-variety communities develop skill, while mixed communities suffer from backward

cultural methods as well as from deterioration of varieties through crossing and mixing of seed.

Experience with the one-variety plan during the last decade has shown that fundamental reforms in the system of production are possible through community organization. The product of organized communities is more uniform, not only because pure varieties are grown but because the cultural treatment is better. The crops are larger and the product more valuable on account of the longer and more uniform staple. The relation to markets is altered as profoundly as the relation to production. In addition to having a readily standardized "unit" product to offer, a genuine community of interest among the producers enables them to deal more constructively with each of the problems of handling the crop. The many new problems that one-variety communities have encountered is evidence in itself that a new basis for constructive effort has been attained. Many undertakings that were entirely beyond the scope of the individual farmer become practical possibilities through community cooperation. At every point of difference the one-variety communities have the advantage over the mixed communities.

One effect of the system of buying is to keep the producing and manufacturing interests apart, out of the range of constructive relations. Though the manufacturers want better cotton and in larger quantities, there is no provision for encouraging the production of better fiber. The commercial system acts rather as a nonconductor between the factory and the farm. As long as the crop is altogether miscellaneous in character and quality and the commercial system remains as it is, there is little prospect of developing the just discrimination in prices that is needed to stimulate improvement of production. The progressive farmer who produces better cotton than his neighbors has too small a chance of getting a better price for his crop.

Discontent or dissatisfaction of farmers with the commercial system leads to many efforts to eliminate or reduce the exactions of the "middleman" through legislation or other restrictive measures, but the need of improving the system of production has not been appreciated. Commercial improvements might become more feasible if the product could be more definitely standardized and its value more definitely known to the farmer as well as to the buyer and the manufacturer.

Merely "cutting out the middleman," as the saying is, would not solve the commercial problem in relation to production. The manufacturers are not in position to buy directly from individual farmers or to see that progressive individual farmers are paid full prices for the few bales of good cotton that such farmers may produce.

scattered about in mixed-variety communities. Assembling, sorting over, and classing the American cotton crop is an expensive operation which unified community production would greatly simplify.

Without discussing the question whether the buyers generally get too large a return for their services in assembling and sorting over the crop to make up the commercial lots that manufacturers buy, attention may be called to the fact that the work done by the buyers in classing and assembling individual bales of the various qualities and conditions of fiber to make up the "even-running" commercial lots would be greatly facilitated if the crop were standardized in production through one-variety community organization. Thousands of men are employed and millions of dollars expended every year in sampling, sorting out, and assembling commercial quantities of the different qualities of cotton before selling to the manufacturers, and much of this effort and expense could be avoided if communities grew one uniform kind and handled their product in a uniform manner. The preliminary for unifying and standardizing the quality of cotton is the planting of uniform seed and giving equal conditions and care to the growing plants, so that regular development may follow and normal maturity may be reached.

Even if the manufacturers were in position to take over the whole system of buying, classing, and sorting the crop, community cooperation would still be necessary for effective improvement of production. On a community basis the buying and other commercial problems are simplified, as shown by the experience of one-variety communities.

CLASSING COTTON IN THE FIELD.

On account of the use of cotton fiber for machine spinning there is a particular requirement that the cotton grower's product shall be uniform in order to be of good quality for manufacturing purposes. Mixtures of long and short staples are worse than useless to the manufacturer and can be sold by the farmer only because unskillful buyers may fail to detect even badly mixed fiber. The simplest and most definite way to detect mixing is to inspect the plants in the field. If a farmer's cotton is not uniform its quality is already impaired. It is impossible that really first-quality fiber should come from a mixed field. Even with short staples uniformity is important, and manufacturers would willingly pay more for really uniform fiber if assured of the "even-running quality" that is their ideal of textile raw material. Notwithstanding the importance of uniformity to the manufacturer, little attention has been given to this problem on the side of production.

The quality of cotton, and especially the uniformity of the fiber, can be judged much more effectively in the field than by the present

system that looks for quality only in samples taken from the bales. By simple inspection of the fields it is easy for those who are familiar with varieties to see whether the plants are all of one kind, or of two or more different kinds, or a miscellaneous mixture of sorts as in the ordinary "gin-run" stocks. If the plants are different and produce different kinds of fiber, the staple will not be uniform in the bale, though it is much more difficult to detect the mixture of different kinds of fiber in the bale than to recognize the different kinds of plants in the field. It is known in long-staple markets that buyers commonly overlook mixtures of 10 or 15 per cent of short staple. Some unscrupulous farmers make a practice of mixing short-staple seed with long-staple Upland varieties and find that even 50 per cent of short cotton can sometimes be sold at the price of long staple, so inadequate is the present system of buying, on samples from the bales.

The true community of interest of the growers is most obvious from the standpoint of production, and practical local organizations would form the most effective connection between the individual farmer and any general organizations that were regularly maintained.

That farmers fail so often to secure fair prices for their cotton under the present commercial system can be charged, in part at least, to the chaotic conditions which tend to keep the farmers from knowing the true quality or value of their cotton, whether bad or good. The entire responsibility of selecting and standardizing the farm product is thrown upon the buyer or upon the commercial system, instead of the standardizing being done on the farm, which becomes possible in one-variety communities.

One-variety communities not only avoid the mixing of seed but are in position to take another important step in standardizing the quality of their cotton by recognizing the effects of different conditions of growth. Pure seed is essential for a uniform product, but favorable conditions of growth are also necessary in order to attain a regular, normal development of the crop. If the soil or the other conditions are adverse, so that the plants fail to grow or are forced into rank growth and then checked by drought or other unfavorable conditions, fiber of very irregular quality is produced. To maintain a continuous normal development of the plants without forcing or checking is the problem of skillful cotton farming.

Farmers of the irrigated districts who leave their cotton too long without water during the heat of the summer not only may cut their yields to half a crop but at the same time impair the quality of the fiber to an equal or greater extent. Bolls do not reach normal development during the water-stress period. The seeds do not grow

to full size, and many have abortive, shriveled embryos, while the fiber is both shorter and weaker than that of the normally developed bolls. Parts of the same field or the earlier or later bolls on the same plants may grow to full size and produce good fiber, but the crop as a whole is inferior. The mixture of weak "perished" fiber from the shriveled, poorly developed bolls impairs the textile quality as definitely as a mixture of short cotton unless the damage is avoided by picking the injured cotton separately. Cotton that develops under uniformly favorable conditions not only yields more but the fiber is of much higher textile value, which undoubtedly would be recognized in the market if a more practical system of buying were developed.

Field-inspection buying could be used to advantage even in mixed-variety communities, to avoid the worst and most uneven stocks or fields injured by unfavorable conditions, but the crop could be much more effectively standardized in one-variety communities, on account of the greater familiarity with the chosen variety and easier and more definite recognition of its characters and behavior. The general tendency of such a system would be progressive in relation to varieties and to careful growing of the crop. Not only the farmer who planted low-quality or mixed seed could be detected and avoided by buyers, but the differences that result from cultural conditions could be recognized in classing the cotton. Organized communities would be able to get the full value of the more uniform fiber that they are able to produce, in addition to the other advantages of using superior varieties.

RELATION OF COMMUNITY PRODUCTION TO DIVERSIFIED FARMING.

Community organization to maintain production of the same kind of cotton from year to year gives a better basis of developing a well-balanced system of agriculture. Regularity of production and uniformity of product are fundamental factors in the utilization, market demand, and commercial value of an industrial raw material. Plunging from one crop or from one variety of cotton to another, so that one year there is a surplus and the next year a "cotton famine," is not properly to be described as diversification, but rather as "wild-cat" agriculture. No sort of cotton can attain its true industrial value without regularity of supply and the development of confidence by the industrial world that the same raw material is to be available from year to year in approximately the same quantities. In other words, stabilizing production, which is possible through community organization and in no other way yet suggested, would be an advantage to the industry, as clearly in the

interest of the manufacturer and of the commercial world as of the farming communities that would standardize their production and place themselves in responsible, constructive relations with the industrial world.

The tendency to speculative campaigns, or "booms," for exclusive or excessive planting of a crop that seems promising is especially strong in the southwestern valleys where new lands are being developed and new crops are being sought to get the high returns that are necessary to meet the cost of irrigation works, leveling the land, and other improvements. Under these conditions stronger tendencies to intensive industrial developments of agriculture are to be expected, away from the older forms of diversified farming that were based primarily upon supplying the needs of the family instead of producing a commercial crop. Instead of expecting a return to more primitive systems of diversified farming, of which there is little prospect in the irrigated valleys, the hope of future progress seems to lie in the direction of balanced systems of production, grouped around special, highly developed industries which receive primary attention as the main source of the farm income. If the chief money crop is to be cotton it is all the more important to hold to one type and variety, so that the quality may be maintained, the culture perfected, and the relations to other crops definitely adjusted.

A suggestion has been made in Arizona and California that community local-option laws might be passed that would make it possible for the farmers of any locality or district to establish the culture of a single variety and secure legal protection against the planting of other kinds of cotton, to the detriment of the community. In the Southwestern States the legal recognition of organized cotton communities would follow the analogy of the system that allows the farmers to organize themselves into irrigation districts, take responsibilities for building dams, canals, or other improvements, and assess the costs against the lands that are in reach of the water supply. Other analogies may be found in the laws that have been passed in many States for controlling weeds, plant diseases, and insect pests or for abating nuisances of other kinds.

There can be no question of the injury that would be suffered by farmers who have established pure seed supplies of a superior variety of cotton if a careless, ignorant, or malicious neighbor should plant an inferior variety or mixed stock. This not only would destroy the value of the surrounding fields for pure seed, but would impair the seed and quality of fiber of the whole community if the inferior seed were taken to the public gin. The underlying principle of such regulations is to assert the right of the community to agree upon and carry through such general community improvements. A system

that allows communities to maintain and utilize superior varieties of cotton has a very close analogy with provisions for carrying through other public improvements, such as roads, drainage, or irrigation works, instead of allowing such progress to be hampered or prevented by careless, backward, or perverse individuals, who may be found in small numbers in any community.

INTEREST IN COMMUNITY DEVELOPMENT.

Progress in cotton communities is not to be expected from external influences or from organization alone, but it depends on local interest inspired by practical understanding and a right public spirit or community point of view. Merely to recognize the advantages of the one-variety plan is not enough. The successful working out of any local application of the plan depends upon the constructive interest and initiative of the community itself, in the same way that the individual farmer must have an active and progressive interest in adopting a cultural improvement, which otherwise he will fail to understand or to use properly. Experience with community work in other places can be utilized, but communities differ no less than climates or soils, and measures of progress have to be adapted to local community needs and developed mainly through local interest and initiative.

That community conditions are so varied and that some communities are so much more ready than others to take up and carry forward such a plan as one-variety organization of cotton production make it the more important to have the plan widely known among agricultural leaders of the cotton-growing regions, whether official or private, so that the most favorable conditions for community development may be found. From this standpoint the improvement of the cotton industry is no longer a merely biological or breeding problem, limited to the technical plant characters, cultural methods, or industrial requirements, but also has a general social or sociological side. Methods of organizing cotton-growing communities need to be devised, studied, and gradually perfected, like methods of organizing industrial corporations, irrigation districts, or other special forms of cooperation.

That pure-seed problems should be considered by sociologists would not be expected, or that plant breeders should study community organization, but there is a common ground of interest and practical cooperation. Breeders of varieties must learn the value and need of community cooperation, while sociologists and economists, as well as teachers and agricultural leaders generally, should take more account of the biological factors that determine the improvement or degeneration of varieties. To devise effective methods of organiz-

ing and conducting the activities of one-variety communities in growing, handling, and marketing the crop and in maintaining the purity and uniformity of the basic stocks are problems of as much practical importance as the original discovery or breeding of the varieties and equally worthy of careful, scientific study, as well as of being popularized and made available for general use.

If the utilization of varieties depended upon finding a new chemical to treat the seed or to fertilize the soil or upon devising a new machine for planting, cultivating, or harvesting the crop, the problem would appear normal, and a solution could be sought along the usual technical lines, but the social factors of community organization need to be considered as well as physical conditions or mechanical operations. The community conditions are equally fundamental, since superior varieties of cotton can be utilized only as they are kept uniform and apart from other varieties. Except through community action there seems to be no prospect of approach to a general application of the science of heredity or the art of plant breeding in the improvement of the cotton industry.

As experience has shown, very intelligent people may fail to understand the essential nature of such an undertaking as one-variety organization of cotton communities. Some are inclined to oppose any form of cooperative effort as "wasting of time and interfering with business." Others may admit the desirability of community organization, but still may not appreciate the fundamental difference in relation to production, that organized communities have good seed to plant while unorganized communities do not. Though the farm operations in one-variety communities are not united but remain as strictly individual as before, the quality and efficiency of farming are improved because knowledge and interest are focused and specialized, with more of a public or social interest to stimulate expression and communication of ideas among the members of such communities.

Since it is an advantage to each farmer that his neighbors also shall plant good seed and raise good crops, there is a basis for a regular, continuous growth of constructive community interest. A community spirit and even a community mind must develop, in order to have consistent and unified community action sustained through a period of years and eventually recognized and established as a normal condition of cotton production. It is a mistake to suppose that the problems of community development are to be solved merely by acquiescence or by getting a majority vote in favor of the one-variety plan. An effective preponderance of public opinion must be established and maintained, and this calls for clear understanding and active interest in the progress of the community as well as in the problems of the cotton industry.

The first problem is to get the general facts that determine the need of organization as clearly understood as possible. Until the need of unified community action is recognized, the interest is likely to wander at any time to other phases of the subject, and even the most incidental. Though many communities would find serious difficulties in reaching an agreement to grow only one variety of cotton, some communities are ready for the step, with the necessary interest and leadership, to enter upon an active course of improvement. Hence, the plan needs to be brought to the attention of those engaged in the investigation of general problems of public welfare, in order that more of the public-spirited interest of active communities be enlisted. On account of these considerations, the improvement of the cotton industry ceases to be merely a botanical or biological problem of discovering new varieties or maintaining select strains and takes on a sociological aspect, to learn how communities should be organized for more effective application of the scientific factors of production.

Leadership undoubtedly is necessary in cotton-community development, as in other forms of social progress, and very patient constructive leaders are needed in cotton communities, at least in the early stages of development, while the farmers are still only partially aware of the needs and possibilities of one-variety organization. Communities in this stage of development may be affected adversely by too much activity, or "drive," on the part of their leaders if a sense of cooperative responsibility is not developed and the local public does not become actively interested and well informed regarding the objects or measures that the leaders may urge. A passive, indifferent community is the more open to groundless suspicion of some private advantage being sought by those who are urging improvements and is ready for obstructive or adverse suggestions. It is to be expected that some elements in each community will consider it a virtue to oppose anything that is being "put across." Hence, the interest of the community must be kept so clearly to the front that it shall not be confused with personal or incidental issues of other kinds.

Not to enlist all of the local interest and constructive ability is to forfeit in advance the hope of getting the best possible results from a community undertaking. Even partial success may have great practical value, but people will go farther if they can believe that the very best is being done and that all of the available talent is being applied to a full understanding of the problems. To know that important practical problems are being worked out, that fundamental reforms are in progress, to which their own community thought is contributing, stimulates interest and constructive effort,

not only in relation to cotton production but in other possibilities of improvement that need to be viewed from the same standpoint of adapting our agricultural activities more fully and effectively to our present state of progress.

The outcome to be expected is that a new association of ideas may develop and become firmly established in the minds of farmers, so that they will think not only of having good seed and raising good crops on their own individual farms but will have an equal appreciation of the practical importance to them of the progress of the community as a whole. To the motive of local patriotism that often is urged for adopting improvements, there is added the direct interest of each farmer in the quality of the community product as a whole, since each farmer stands very clearly to get more for his cotton and to have a better assured market for future crops if his neighbors are also raising the same kind of cotton and the quality of the variety is being maintained. An established reputation and assured market for a staple product are practical assets for a community, tending to increase the value of property and encourage public improvements.

In communities that are not yet united for constructive work it is better to place the first emphasis upon the general advantages of one-variety organization rather than to insist upon the superiority of a particular kind of cotton. It often is not possible to say which variety is the best that can be had. Choice of varieties is limited generally by the fact that stocks of pure seed are obtainable for only a few kinds. The first one-variety communities in each district will profit especially by selling seed to other communities, which is an immediate advantage in the early years of community development, before the marketing and other features have had local demonstrations. This consideration naturally will get preference for varieties that have good prospects of general use, as distinguished from those that require special conditions or are not widely known. Pure seed often sells as readily in carload lots as in bushels or tons.

Local experiments may be needed before the variety question can be settled, and seasonal fluctuations of behavior may be very misleading, so that several years may be required to reach definite results. But even a poor variety will give better results with community handling than good varieties mixed together. An organized community can change promptly to a superior variety when a definite advantage can be shown and seed can be obtained in sufficient quantity. The Pima variety was substituted for the Yuma in the Salt River Valley, Ariz., in the season of 1917, after a sufficient stock of seed had been raised to plant the entire acreage.

COMMUNITY UTILIZATION OF VARIETIES.

Considering that adequate supplies of pure seed are the first requisite for extending the use of any superior variety of cotton, it follows that any good variety must have a central localized production at first, whatever the later developments. This is especially necessary with varieties developed by the United States Department of Agriculture, which have a serious handicap at first in the seed being distributed free instead of going out as high-priced advertising novelties, sold very often at several dollars a bushel. Distributing the seed widely does not increase the supply, since little reliance can be placed upon seed that is raised by individual farmers in mixed communities unless special precautions of isolation and separate ginning are taken. The fate of most varieties is that they are not localized sufficiently to keep the seed pure, so that the scale of commercial production is scarcely reached before the variety begins to deteriorate. Hence, varieties of cotton are "short lived" unless a basic seed stock is preserved by continued isolation and selection. A variety no longer exists in a practical sense when uniformity is lost and the work of selection undone. The only varieties that have been useful are those that have been maintained for periods of years, in most cases by the original breeders, who established centers of production and seed supply in their surrounding communities through the practical inducement of buying or helping to find markets for the seed that their neighbors produced.

Localization of varieties in this necessary and constructive way is more common in Texas than in any of the States to the east, possibly because the boll-weevil invasion reached Texas first and there has been more time for readjustment. Another reason is that the eastern Upland varieties are not well adapted to the Texas conditions, so that the farmers have learned to depend on their local varieties instead of bringing seed from Georgia or the Carolinas, as the custom formerly was. Holding to the big-boll type of cotton has rendered the Texas crop generally more uniform, and a distinct market advantage is now recognized as a result. Although only a few communities have as yet undertaken a strict adherence to a single variety, the fiber quality and staple length of the Texas big-boll varieties—Triumph, Lone Star, and Rowden—are not so different as many of the varieties that are grown in other parts of the country, so that the Texas crop as a whole is of more uniform quality. But now it is being recognized that this advantage can be increased by more definite local specialization, and many Texas communities and districts are approaching the one-variety status.

In view of the requirement of seed supplies to make utilization possible, it is obvious that any variety which attains prominence and

holds its standing through a period of years must have somewhere a local base, where continued interest exists and precautions of selection and isolation are applied to keep up the stock and maintain the supplies of good seed. Local adoption and popularity of a variety, to the extent of having it planted by many neighboring farmers, is necessary for the development of a select stock to the scale of commercial production. Hence, such a nucleus or life center may be looked for with any variety of note. The town of Lockhart, Tex., has wide agricultural fame as the home of Triumph cotton, the most prominent variety of the Texas big-boll type, bred and maintained for many years by Alexander Mebane. A similar distinction is enjoyed in South Carolina by Hartsville, in Darlington County, as the center of production and seed supplies of the Columbia, or "Webber," variety. This was bred originally from Russell's Big-Boll by Dr. H. J. Webber, while connected with the United States Department of Agriculture. The first distribution of seed of Columbia was in 1907. The importance of the work of D. R. Coker in maintaining the seed stocks and establishing market relations for this new type of Upland long-staple cotton has been recognized in several publications of the United States Department of Agriculture.

The original home and center of seed supply of the Trice variety were around Jackson, Tenn., where the variety was bred by the late Prof. S. M. Bain, of the Tennessee Agricultural Experiment Station. The first distribution was made in 1909, after several years of careful selection and isolation of the stock. That these varieties and others have tended so strongly to remain localized and the seed supplies restricted, although well adapted to cultivation over large regions, is in itself an evidence of the need of giving attention more directly to the utilization and seed-supply problems.

A general plan of community cotton improvement has been followed for several years by the North Carolina Department of Agriculture and has been very successful in assisting farmers to appreciate the value of good varieties and good seed. A policy of first narrowing down to a few good varieties has been followed, as leading gradually to an appreciation of the practical advantages and advisability of using only one variety in a community. Local variety tests are conducted to enable the farmers of a community to select what they consider as the best from a series of promising varieties. Some communities have narrowed down to two or three varieties, while some keep four or five varieties in cultivation, but the number is being reduced every year.

The need of standardizing on the production of one variety is realized, and in Edgecombe County, in the east-central part of North Carolina, a general organization for planting a single variety has

been perfected recently. According to recent information from Prof. C. B. Williams, 58 communities have been organized in different parts of the State, and marked improvements in the crop are reported. A general report of the community work published in 1920 states that an average increase of $28.97 per acre over a period of five years was obtained from the use of the selected varieties instead of ordinary gin-run seed. An estimate of $41,000,000 is made in an article by F. H. Jeter in the Progressive Farmer as the amount that would have been added to North Carolina farmers' bank accounts if they had all used the varieties of cotton best suited to their needs.[7]

Although distinct and valuable progress undoubtedly can be made by getting farmers to plant good seed and discard inferior stocks, even without adopting the one-variety plan, it nevertheless is plain that the full objects and possibilities of improvement will not be attained. Testing varieties of cotton to determine which is the best for any locality is not easy, on account of the wide fluctuations of seasonal conditions and behavior that must be taken into account before a reliable conclusion can be reached. Even with only two or three varieties in a community many precautions of isolation and separate ginning must be observed. Ginning difficulties are reduced by having certain days to gin the cotton of the different varieties for seed purposes, but thorough cleaning of the gins requires time and labor. Even with the best intentions both the cotton and the seed are likely to be mixed somewhat unless very careful and persistent attention is given. Without these precautions there is the necessity of obtaining new seed of the popular varieties every two or three years. Not only are these difficulties to be avoided by community organization, but one-variety communities are able to sell seed instead of having to buy new stocks frequently.

PIMA COTTON COMMUNITIES.

The oldest and best established one-variety community is in the Salt River Valley of Arizona, where the Pima variety of Egyptian cotton is grown exclusively. The nature of this development needs especially to be understood because of the efforts that have been made to repeat the successes of the Salt River Valley merely by taking the seed of the Pima variety to other districts, without understanding the one-variety plan that has made it possible to establish the new industry in Arizona and that the same plan may be of value even beyond the range of the Pima variety. Experiments have shown that the Egyptian type of cotton is much better adapted

[7] Jeter, F. H. Your community's cotton reputation. How some communities are building good cotton names and capitalizing them. *In* Prog. Farmer, v. 36, no. 5, p. 358. 1921.

to the conditions of the irrigated valleys than any of the long-staple Upland or Sea Island varieties that are raised in the eastern Cotton Belt and that, on the other hand, there is no prospect of establishing the Pima cotton in Texas or farther east, on account of its susceptibility to the black-arm disease and to weevil injury.

Undoubtedly it was much easier to establish the Pima cotton and increase the stocks of pure seed in a new community where there were no other varieties of cotton. Also the need of cooperation undoubtedly was more readily appreciated in the irrigated valleys, where people are accustomed to combined action in relation to securing water, building irrigation works, digging drainage canals, and other agricultural undertakings. Nevertheless, the agreement of the community to plant only one kind of cotton is a matter quite apart from other cooperative undertakings and very easily accomplished when the advantages are sufficiently understood.

On the other hand, there were special difficulties to face in the Salt River Valley in the marketing of a new variety of cotton, not grown anywhere else and somewhat different from the imported Egyptian cotton. After the markets were once secured the Pima cotton industry made very rapid progress and began to attract the attention of other cotton-growing regions. A rapid extension was possible because larger supplies of pure seed were available than of any other variety. Adherence of the entire community to the one variety of cotton made it possible to keep the seed pure and to raise much larger quantities of uniform high-quality fiber than could be grown in mixed-variety communities.

The seed supply of the Salt River Valley is maintained by the original organization of growers of Egyptian cotton in the district around Tempe, with the assistance of the Bureau of Plant Industry in selecting the basic stock and roguing the increase fields. The seed that is to be used for planting is raised in special districts that have been planted with rogued seed of the previous year. The exchange conducts a gin which is devoted exclusively to the cotton that furnishes the seed for planting. All of the standard-quality seed has been handled through this organization, the Tempe Cotton Exchange, and furnished to the farmers each year at the price of oil-mill seed plus the cost of delinting, sacking, storage, and insurance. On account of very high prices for sacks and other incidentals, as well as for the labor of handling the seed under the necessary precautions, the various items of expense amounted in 1919 to $17.44 per ton in addition to the oil-mill price of seed, which stood at $65 during the war period. There was not enough first-quality seed for planting the very large acreage of 1920, and other seed was used in some outlying districts.

The growers in the Salt River Valley also maintain an organization for dealing with the labor problems and bringing the cotton pickers from Mexico each fall, which are necessary for the harvesting of the crop. The money required to meet such general expenses of the cooperative industry is raised by a tax of $4 on each bale, collected at the gin. The importance and scope of this organization may be realized from the fact that in the season of 1920 it was necessary to bring about 15,000 cotton pickers from Mexico to assist in harvesting the Salt River Valley crop of about 180,000 acres of Pima cotton.

Special encouragement was given to the development of the Pima industry during the war period, as a prospective military necessity. With the boll weevil present in the Sea Island districts, the possibility of a sudden and complete failure of the crop was foreseen in the event of an unfavorable season, and this actually occurred in 1919, when the production of Sea Island cotton fell to less than 7,000 bales, from 52,000 bales in 1918 and 92,000 bales in 1917. Thus, if the war had continued another year the Pima cotton of Arizona would have been the only raw material in the United States available for making airplane wings, balloon fabrics, and other military equipment requiring special strength and durability.

It was reckoned with much satisfaction in Arizona that the Pima cotton crop of the Salt River Valley communities in 1919 returned about $20,000,000, or nearly twice the cost of the Salt River reclamation project, including the Roosevelt Dam, electric power plants, and irrigation canals. The value of land suited to cotton also doubled or trebled in a few years, some of it selling at $500 per acre, or even higher. With reduced production in Egypt and loss of the Sea Island crop through the boll weevil, the automobile-tire industry appeared to be acutely dependent upon the Pima cotton raised by the southwestern communities. In the spring of 1920 manufacturers offered to guarantee a minimum price of 60 cents a pound, and some contracts were made at 80 cents a pound, which encouraged further rapid extension of Pima cotton not only in the Salt River Valley but in the Yuma, Imperial, Coachella, and San Joaquin Valleys. Altogether about 180,000 acres of Pima cotton were planted in the Salt River Valley in 1920 and nearly 250,000 acres in all of the irrigated valleys, notwithstanding the very high costs of production that resulted from speculative conditions.

The losses that have followed the world-wide commercial collapse of the autumn of 1920 resulted in greatly restricted planting in 1921, but this setback has no relation to particular varieties of cotton or to local questions. The entire cotton industry, not only of the United States but also of foreign countries, was affected in the same way, by a general reaction from speculative inflation of values during the

war-time period of abnormal industrial activity. The superior quality of the Pima cotton in the Salt River Valley and the development of the cooperative spirit undoubtedly assisted the community in avoiding more serious injury.

MEADE COTTON COMMUNITIES.

Meade cotton is a remarkable new variety of the Upland type that is being substituted in South Carolina and Georgia for the Sea Island type of cotton, which is being abandoned on account of the ravages of the boll weevil. Although the Meade plants have the general appearance and behavior of ordinary short-staple Upland sorts, the fiber has the length and quality of Sea Island cotton, with a staple of 1⅝ inches under favorable conditions. The seeds also are like those of Sea Island cotton and adapted with a slight readjustment of the machinery to roller ginning that planters have used hitherto for the Sea Island crop.

Having the cultural advantages of the Upland type, large bolls, prompt setting of the crop, and earlier maturity, the Meade variety usually yields as much as short-staple varieties and two or three times as much as the Sea Island cotton in the presence of the boll weevil. This advantage has been shown in several different experiments, with the two types grown side by side for purposes of comparison. The need of a special variety in the Southeastern States and the opportunities of a special market are as great as or greater than with the Pima cotton in Arizona, but community conditions are less advanced, and less progress has been made in the utilization of the Meade cotton.

At the beginning of the commercial cultivation of the Meade variety in Georgia, in 1917, the need of developing adequate seed supplies was recognized and efforts were made to concentrate the best stocks of seed in the communities that gave the best prospects of regular organized action for keeping the seed pure. But many of the farmers who grew the Meade cotton in 1918 failed to observe the precautions of isolation and separate ginning that had been agreed upon, and many stocks of seed became worthless for planting. Although the acreage increased rapidly and the reception of the new variety in the market could hardly have been better, the lack of sufficient quantities of pure seed or of any definitely organized basis of pure-seed production hampered the utilization of the variety.

More care was taken in 1919 for isolation and separate ginning than in the previous year, but the advantages to be gained by community organization and cooperation and the mutual interest of the farmers of a district in the production of one kind of cotton were not sufficiently appreciated by the growers to resist offers of high

prices from distant points. Instead of holding together as communities and reserving the seed for their neighbors, to increase the volume of production and of seed supply in their own districts, many of the farmers sold their seed for the fancy prices that were offered from other States, and even from foreign countries. As a result, Meade cotton was reported in 1920 from many quarters outside of the Sea Island belt, including rather large acreages in Arkansas and Texas, and still larger in Haiti. Even in Georgia and South Carolina the planting of Meade cotton has not been confined to the Sea Island districts. Indeed, the most active interest and cooperation in maintaining the variety and the largest stock of pure seed thus far developed are in southern Georgia, in a district east of Albany, in Worth County, between Acree and Sylvester.

Though reports of favorable results from other States or from foreign countries may indicate wider possibilities of use for the variety, it needs to be recognized that premature expansion of acreage, beyond the supply of good seed, only invites unfavorable market reactions from the irregular and inferior fiber that is sure to result from the planting of mixed seed. To the extent that crops continue to be grown from mixed seed, the history of the Floradora variety is likely to be repeated with the Meade cotton. Though Floradora was essentially inferior to Meade on account of the tendency to the "butterfly" condition, with short fibers at the base of the seeds, the disappointment will not be less if the Meade cotton becomes mixed and is allowed to degenerate. The Floradora variety was pushed into prominence by advertising, and seed was sold in many districts at high prices, but the fiber was very irregular and soon lost its place in the market. The danger is that buyers of Meade cotton, with the usual failure to discriminate, at first will accept the mixed stocks at the same prices as the uniform fiber, until the manufacturers find the mixed cotton too "wasty" and refuse to continue their purchases. Market reports of Meade cotton being sold much below Sea Island no doubt refer in many cases to inferior mixed stocks rather than to genuine, uniform Meade fiber.

In addition to the assistance that has been given to growers of Meade cotton in connection with the experimental work of the Department of Agriculture in the breeding and local adjustment of the variety, organization of Meade communities is now being actively encouraged by the extension service of the Georgia State Agricultural College. Ten different communities have been selected by the State agents as representing the best conditions and opportunities for entering upon the production of Meade cotton. A special effort to plant these communities with pure seed is to be made, and assistance is to be given in maintaining uniformity of stocks through selection, with isolation of fields and separate ginning. Market facilities are

also being organized, in order to secure to the farmers the full advantages of producing better cotton and a higher quality of seed.

A reason why the farmers did not better appreciate the need of maintaining their supplies of Meade seed is doubtless to be found in the local custom of renewing the stocks of Sea Island seed every two or three years from the South Carolina Sea Island plantations on the islands near Charleston. It was the general belief in the Georgia and Florida Sea Island districts that the quality of the fiber deteriorated when grown on the mainland and was found to "run out," so that new seed must be purchased every few years. The reason for the deterioration of the quality of Sea Island cotton on the mainland was not generally recognized, but was largely because the growers failed to isolate their Sea Island cotton from short-staple Upland cotton, which commonly was grown on the same farms and often in adjacent fields. Although the seed did not go to the same gins, crossing took place in the fields, and only a few seasons were needed to mongrelize the Sea Island crop.

On the other hand the former growers of fine Sea Island cotton on the islands around Charleston, who supplied the new seed for the mainland districts, had a system of their own for maintaining the high quality and uniformity of their product. They grew only Sea Island cotton, selected their planting seed every year, and ginned their crop on their own private gins. This may be considered as the last genuine survival of the old plantation system of private gins. Although private plantation gins still exist in other districts, where Upland cotton is grown, they seem not to be utilized for maintaining supplies of pure seed.

The islands around Charleston were also the last of the Sea Island districts to be invaded by the boll weevil, and to this fact is attributed much of the difficulty of producing an adequate supply of pure Meade seed. The mainland growers had not been accustomed to maintain their own seed supplies and growers of seed on the islands around Charleston did not appreciate the necessity of substituting the Meade variety until their Sea Island cotton had been destroyed by the weevils.

Now that the boll weevil has invaded the islands better progress is being made with the Meade cotton, as evidenced by the number of former Sea Island growers who are planting it on a large scale this year. With favorable results there is every prospect that the essentials of community production may be met with the Meade cotton, at least to the extent of maintaining the seed supplies.

The idea that the Sea Island or the Meade cotton might be grown in the Southwest instead of Egyptian cotton has naturally suggested itself, but neither of these long-fiber types has shown promise in the irrigated valleys where the Egyptian cotton thrives. The plants

do not refuse to grow, but usually the crops are small, the bolls not well opened, and the fiber weak. That the different varieties and types of cotton are thus limited to the conditions of particular regions is another reason why local centers of seed supply need to be developed and maintained.

DURANGO COTTON COMMUNITIES.

Communities in several States are now specializing on the production of Durango cotton, and some of them are planting this variety alone. Although very good results were obtained with Durango cotton in Texas, around Waco and Clarksville, several years ago, the growers did not keep their seed separate or maintain the variety in cultivation. The first extensive plantings, about 6,000 acres, were made in the Imperial Valley in southern California in 1913, and organized efforts for community production were continued for several years, but without establishing a one-variety condition or maintaining the seed supplies.[8]

One of the principal difficulties encountered in the Imperial Valley was that the Durango, like other long-staple Upland varieties of cotton, was injured seriously by water shortage and resulting conditions of drought. Though the short-staple varieties suffer also from drought, the prices are not so seriously affected as with the longer staples, that are bought with some discrimination of quality. With no adequate provision for maintaining pure seed, the Imperial Valley stocks of Durango deteriorated rapidly, although rather large acreages continued to be planted, and commercial stocks of seed were sent to the Yuma, Palo Verde, Coachella, and San Joaquin Valleys, but in all these cases on a basis of mixed-variety plantings that did not make it practicable to keep the seed pure. A stock of Durango seed, somewhat mixed with short staple, was sold in the Yuma Valley in 1919 as "Rowden," notwithstanding the fact that this name belongs to an entirely different Texas big-boll variety not grown in Arizona or California. In 1920 "Long-Staple Improved Rowden" was brought to northern Texas and advertised as a valuable novelty from California.

The most recent addition to the California cotton areas is the Perris Valley, south of Riverside, where Durango cotton is being planted exclusively and the growers have a rather compact organization, with a community gin. Stocks of pure seed have been secured and are now being increased under conditions of isolation and separate ginning to replace the mixed lots that unfortunately were obtained in 1919, the first year of extensive planting. It is significant

[8] See McLachlan, Argyle. Community production of Durango cotton in the Imperial Valley. U. S. Dept. Agr. Bul. 324, 16 p. 1915.

that the best stocks that were obtainable in commercial quantities in California in 1920 were from seed of an isolated planting in Fresno County that had come three years before from the Pecos Valley in New Mexico, where Durango cotton has been grown since 1915 and care has been taken to maintain the selection of the variety in cooperation with the United States Department of Agriculture. The complete deterioration of other stocks of Durango seed in California under the usual conditions affords a further demonstration of effects of the system of mixed-variety plantings, only somewhat more striking than usual on account of the admitted superiority of this variety under the southwestern conditions, where it had proved to be better adapted than any of the eastern Upland sorts that produce staple of equal length, 1¼ inches under favorable conditions.

Durango has been the principal variety in the Pecos Valley of New Mexico since 1917, because of precautions of continued selection, isolation of seed stocks from other varieties, and separate ginning. This valley has been the source of supply for large quantities of good Durango seed for several years, but unfortunately has been invaded by the pink bollworm, so that seed is not available for shipment to other regions on account of the danger of spreading this dangerous pest. Nevertheless, the Pecos Valley growers are striving to complete a one-variety organization on the basis of Durango cotton.

The New Mexico College of Agriculture is assisting the growers in this effort and reported very favorable results in 1919:

> Both short-staple and Durango cotton have been tested out for a number of years, with the result that now by far the largest per cent of all cotton produced in that district is Durango; and many forces are being brought to bear to eliminate the growing of any other variety.

In that season Durango cotton brought from 20 to 25 cents a pound more than short-staple varieties. An average yield of 1.35 bales to the acre was also reported for the three years that the variety had been grown at the New Mexico Agricutlural Experiment Station.[9]

A Durango cotton community was established in 1920 in Cameron County, Tex., in the lower Rio Grande Valley, in the region about Harlingen, on the basis of a carload of seed from Carlsbad, N. M., and a report has been published that includes the following statement:

> This seed was planted by a large number of farmers under all conditions to be met with in the Lower Rio Grande Valley during the season of 1920. Reports from the growers to the county agent's office show that the new variety averages $27.56 greater acre value than the varieties commonly planted and that

[9] Stewart, Rupert L. Cotton growing. N. Mex. Agr. Exp. Sta. Bul. 120, 16 p., 4 figs. 1919.

this carload of seed brought the farmers a little more than $66,000 over what would have been received had the same acreage been planted in the short staples.

In comparison with the short staples on the same farms, it appeared that Durango had the best of the argument, and many farmers will plant it exclusively this season. The county agent is now urging the next step in the evolution—community production, in order to keep pure seed stocks and provide quantity lots of even grade and staple. This will bring better returns by enabling the growers to market direct to the mills or to the exporters, which they will do by selling through their association.

The Rio Grande Long-Staple Cotton Association is the final result of this campaign, and it is modeled after the most approved plans for commodity marketing on strictly cooperative lines. With this association in charge the county agent will be enabled to turn his attention to other matters for the good of this county, while the association "carries on" to the ultimate goal of every producer—greater net profits per acre.[10]

ACALA COTTON COMMUNITIES.

A new Upland variety called Acala, acclimatized from Mexico a few years ago, is being planted extensively in Oklahoma and northern Texas, because Acala is somewhat earlier than other Texas big-boll varieties, has longer fiber, and is more stormproof, although easy to pick. The fiber is abundant and the locks hold well together, so that all of the cotton comes out of the open boll with one movement of the hand.

The fiber is somewhat longer than in Lone Star, 1⅛ to 1 3/16 inches under favorable conditions, and of good quality. Averages of 25 reports of field production of different varieties in Oklahoma in 1920, published in the Oklahoma Marketing Bulletin, dated January 20, 1921, show that Acala was a week earlier than other leading varieties, outyielded them to an extent of more than 200 pounds of seed cotton per acre, had a higher percentage of lint (36 instead of 32 or 33), and a superior staple that commanded a distinctly better price in the market. Premiums of 2 or 3 cents a pound usually are obtained, and sometimes as high as 10 cents or more above the price of short staples.

On account of these distinct advantages, efforts are being made in many localities in Oklahoma to utilize Acala cotton and eliminate all other varieties. A general plan of community standardization of production has been adopted by the State extension service of Oklahoma. Instead of merely local communities or gin units, entire counties or larger districts are urged to restrict themselves to a single superior variety. Several private firms of seed dealers, both in Oklahoma and in Texas, are specializing in the production of Acala seed for planting purposes.

[10] Richardson, T. C. Move for a longer staple. World demand is for a better cotton. *In* Farm and Ranch, v. 40, no. 10, p. 27. 1921.

A new Acala community has been organized recently in the Coachella Valley of California, for the dual purpose of raising a uniform product and developing large stocks of pure seed to supply other irrigated valleys or for shipment to Texas or other eastern States in seasons of crop failure or scarcity of planting seed, as in 1920. Interest has been attracted especially by the fact that very large yields, at rates between 2 and 3 bales per acre, were obtained in the season of 1920 from two small plantings of Acala cotton grown at the Government date garden, about 2 miles west of Indio.

The cotton growers in the Coachella Valley have organized into an association, and the seed grown at the Government date garden is to be used as the basic stock. The date-garden plantings were well isolated and ginned with every precaution to avoid any admixture with other varieties, and another stock of good Acala seed was obtained from an isolated planting near Bakersfield, Calif., so that there should be no occasion to plant any other kind of cotton in the valley. The best of the Acala seed is planted on isolated fields, away from any other variety of cotton or from fields that have grown cotton recently. Arrangements have been made to have one gin reserved exclusively for Acala cotton.

On the basis of such precautions it is expected that seed raised in the Coachella Valley may have special value for planting purposes, not only for local use but for shipment to other cotton regions that do not have good planting seed. The cooperation of the Department of Agriculture of California is being sought by the Acala association for inspecting the fields and certifying the quality of seed, with such assistance as can be given by the United States Department of Agriculture in roguing and selection work. Thus it may be possible to develop in this valley, isolated from other cotton-growing districts, an Acala seed stock of the highest quality.

COMMUNITY UTILIZATION OF LONE STAR COTTON.

The Lone Star variety, representing the Texas big-boll type of cotton, somewhat similar to Triumph, or Mebane, and Rowden, is now grown very extensively in Texas and adjacent States, and even as far east as North Carolina. The Lone Star seed supplies have been centered chiefly in northern Texas, and especially in Hunt County, around Greenville. A field station has been maintained for several years at Greenville by the United States Department of Agriculture for the study of breeding and cultural problems of cotton.

On account of the superiority of the fiber of the Lone Star cotton, which often attains a length of 1⅛ inches under favorable conditions, and often brings a premium of 2 or 3 cents a pound, and sometimes more, the Lone Star communities have important ad-

vantages. For Hunt County alone it was figured several years ago that replacing other varieties with Lone Star increased the returns to the farmers by about $700,000 in a single season.

The importance of maintaining and utilizing the variety by keeping up the supplies of good seed is so well appreciated in the community of Greenville that a tract of 60 acres of typical black-land soil was secured and made available for the use of the seed-breeding station, under cooperative arrangements with the Chamber of Commerce of Greenville.

Selection of the Lone Star variety is being maintained on the basis of pedigreed progeny stocks, with the cooperation of many farmers. Owners of the farms surrounding the seed-breeding station have agreed to plant only the Lone Star cotton or some variety recommended by the station, so that the basic stocks of the variety can be protected from contamination.

Another center of Lone Star seed production is being developed in southern Texas, around Tivoli and Austwell, in Refugio County, north of Corpus Christi, with precautions of continued selection, roguing, isolation from other cotton, and separate gins where this variety is handled exclusively. With these precautions extended over large acreages, high-quality planting seed can be made available in carload lots to other districts.

In the spring of 1920, after all the stocks of good seed in northern Texas had been exhausted, a carload of seed from Austwell was ordered by express for growers of the Lone Star variety around Greenville, in order to replant their cotton, which had been destroyed repeatedly by bad weather. In addition to the price of the seed, the growers paid $800, or 75 cents a bushel, in shipping charges to get the seed promptly and avoid the necessity of using inferior seed or sacrificing the crop. That the seed was obtainable in southern Texas appeared very fortunate, to avoid a still more serious impairment of supplies of good Lone Star seed around Greenville as a result of very bad seasons in 1919 and 1920. The lesson of such an emergency is that dependence should not be placed upon any single district to furnish all the supplies of good seed of any important variety, but many communities, preferably in distant regions, should maintain supplies of pure seed that can become available when needed.

CONCLUSIONS.

How to preserve and utilize superior varieties of cotton is a problem worthy of scientific study, no less than the methods of developing varieties by breeding and selection. In most of our cotton-growing communities varieties are not preserved or utilized properly and are subject to rapid deterioration as a result of frequent buying of new

sorts, mixture of seed at the public gins, and crossing of different kinds in the fields.

Varieties of cotton mongrelize rapidly through mixing and crossing, with a resulting loss of the uniformity of select stocks, small yields, irregular fiber, inferior textile quality, and lower market price. Such mixing and deterioration take place inevitably in all communities where different kinds of cotton are grown on neighboring farms and taken to the public gins, as is the general custom. Most of the farmers plant ordinary "gin-run" seed, a mixture of many varieties and mongrel, degenerate forms.

The popular idea that varieties of cotton "run out" rapidly and need to be replaced frequently by new sorts has as a basis of fact that degeneration undoubtedly is caused by the mixing of seed and crossing of the different kinds in the fields. No variety can be kept in a pure, uniform condition if selection and isolation are neglected. The only way to preserve a variety and develop a large stock of pure seed is to grow only one kind of cotton in a community, so that there is neither crossing in the fields nor mixing at the gins to destroy the effect of selection.

Since the usual conditions of mixed-variety production do not make it possible to develop stocks of pure seed of sufficient volume to provide for full use of a variety, exclusive community production of single varieties is a necessary precaution to maintain adequate stocks of pure seed for general planting over large areas. Community organization of production is the most effective way of utilizing superior varieties and of applying the results of scientific investigation of problems of heredity and breeding.

Wider utilization of superior varieties is needed, especially at the present time, in order to advance the quality of our cotton and avoid the competition that is being developed rapidly in foreign countries. Full utilization of varieties is not to be expected unless stocks of pure seed are maintained and increased for general planting over large areas. A very striking demonstration of the advantage of one-variety cotton communities has been secured in the Salt River Valley of Arizona, where only the locally selected Pima variety of Egyptian cotton is grown and now is represented by a larger stock of pure seed than any variety in the eastern Cotton Belt.

Manufacturers have complained for many years of a general and gradual decline in the quality and uniformity of American cotton, and this may be ascribed to the substitution of large public gins for the old system of private plantation gins during the half century since the Civil War. During the same period separately operated small farms and tenant holdings have taken the place of the larger plantation units of production, which doubtless has increased the

tendency to mixing and degeneration of varieties. But this tendency may be counteracted by organizing one-variety communities.

Though larger units are desirable, the practical minimum of organized production is the gin-unit community, to include all the farmers who take their cotton to the same gin. Separate ginning and isolation and roguing of seed fields is essential to organized effort for utilizing superior varieties of cotton. The mixing of different kinds of seed at the gins is the chief agency of deterioration of varieties, and must be avoided if other precautions are to be of practical value.

Except for the deterioration that results from the mixing and the crossing of different sorts there is no basis of fact for the popular idea that varieties of cotton run out rapidly or need to be changed frequently. With precautions of isolation, careful selection and roguing of the seed fields, and separate ginning, a variety of cotton can be kept pure and uniform and grown for many years. Production should be stabilized by the continued use of standard varieties. New sorts should not be substituted until their superiority is definitely shown and such seed supplies are available that whole communities can change at one time. It is wasteful of good seed to send it out to scattered individual farmers in mixed-variety communities where isolation and separate ginning are not provided.

Numerous varieties of cotton are unnecessary and undesirable both for agricultural and for industrial reasons. The commercial practices of introducing many new kinds or of renaming old varieties to meet popular demands are based on a misunderstanding of the facts and do not tend to improve production, but add to the mixture of the "gin-run" seed.

Though many varieties of cotton have been bred and distributed by the United States Department of Agriculture, only those are being maintained and extended on a scale of commercial production that have been adopted and centralized in communities so as to provide larger supplies of pure seed. Experience of nearly two decades has shown that the breeding and distribution of seed of superior varieties, either by the United States Department of Agriculture or by local or private efforts, does not result in any general improvement of production, because of the lack of any adequate system for developing and maintaining large supplies of pure seed. Studies of utilization and of seed-supply problems have shown no way to develop and maintain adequate supplies of pure seed of superior varieties and keep such seed supplies permanently available except in one-variety communities where the mixing of seed at the gins and the crossing of varieties in the fields are avoided.

Experience of several years in one-variety communities established in irrigated valleys of the Southwestern States has demon-

strated the practical value of the one-variety plan and the importance of extending it to other regions. Not only supplies of good seed but cultural improvements and marketing problems can be worked out to better advantage in one-variety communities on account of the better basis of production. More active interest and greater skill in the handling of the crop are developed when the attention of all the farmers of a community is directed to a single superior variety instead of being confused and dissipated by the presence of different varieties and inferior mixed stocks. Hence, a careful consideration of the one-variety plan may be urged upon those who are interested in any measures of improvement in the cotton industry. In view of the enormous wastes of the present system there should be no unnecessary delay in utilizing the varieties and other improvements that are possible and ready to be applied as soon as the farming public is sufficiently informed.

LIST OF PUBLICATIONS ON COMMUNITY COTTON IMPROVEMENT.

The following list includes publications issued by the Department of Agriculture and a few other papers that treat of improvement of the cotton industry through community organization, in order to utilize superior varieties and maintain pure seed supplies:

Cotton selection on the farm by the characters of the stalks, leaves, and bolls. By O. F. Cook. Bureau of Plant Industry Circular No. 66. Issued August 13, 1910.

Cotton improvement on a community basis. By O. F. Cook. Yearbook for 1911, pp. 397–410. See also report of the Chief of the Bureau of Plant Industry for 1911, p. 24.

Selection of cotton and corn seed on southern farms. By S. A. Knapp and J. A. Evans. Bureau of Plant Industry Document No. 747. (Farmers' Cooperative Demonstration Work No. "A"–67.) Issued May 11, 1912.

Factors affecting the production of long-staple cotton. By O. F. Cook. Bureau of Plant Industry Circular No. 123, pp. 3–9. Issued April 26, 1913.

Cotton problems in Louisiana. By O. F. Cook. Bureau of Plant Industry Circular No. 130, pp. 3–14. Issued June 21, 1913.

The relation of cotton buying to cotton growing. By O. F. Cook. U. S. Dept. of Agriculture Bulletin No. 60. Issued February 16, 1914.

Custom ginning as a factor in cotton-seed deterioration. By D. A. Saunders and P. V. Cardon. U. S. Dept. of Agriculture Bulletin No. 288. Issued September 7, 1915.

Community production of Durango cotton in the Imperial Valley. By Argyle McLachlan. U. S. Dept. of Agriculture Bulletin No. 324. Issued December 22, 1915.

Community production of Egyptian cotton in the United States. By C. S. Scofield, T. H. Kearney, C. J. Brand, O. F. Cook, and W. T. Swingle. U. S. Dept. of Agriculture Bulletin No. 332. Issued January 13, 1916.

Tests of Pima Egyptian cotton in the Salt River Valley, Arizona. By T. H. Kearney. U. S. Dept. of Agriculture, A. & D. R. P. Circular 1. Issued December 6, 1916.

Extension of cotton production in California. By O. F. Cook. U. S. Dept. of Agriculture Bulletin No. 533. Issued March 3, 1917.

Production of American Egyptian cotton. By C. S. Scofield, T. H. Kearney, C. J. Brand, O. F. Cook, and W. T. Swingle. U. S. Dept. of Agriculture Bulletin No. 742. Issued January 15, 1919.

Cotton improvement under weevil conditions. By O. F. Cook. U. S. Dept. of Agriculture, Farmers' Bulletin 501 (revised edition). Issued October, 1920.

Cotton a community crop. By O. F. Cook. Journal of Heredity. Issued April, 1920.

Commercial parasitism in the cotton industry. By O. F. Cook. Nature (London). Issued July 1, 1920, pp. 548–549.

Community cotton improvement in North Carolina. By R. Y. Winters, S. W. Hill, and P. H. Kime. North Carolina Agricultural Extension Service Circular 108. Issued September, 1920.

Your community's cotton reputation. How some communities are building good cotton names and capitalizing them. By F. H. Jeter. The Progressive Farmer. Issued January 29, 1921, p. 130.

The cotton variety problem. By J. S. Cates. The Country Gentleman Issued March 5, 1921.

Adelanto en el cultivo del algodón. By O. F. Cook. Boletín de la Unión Pan Americana. Issued March, 1921, pp. 273–294.

City and country. By O. F. Cook. The Journal of Heredity. Issued March and April, 1921.

Improvements in cotton production. By O. F. Cook. U. S. Dept. of Agriculture Circular 200. Issued November, 1921.

Cotton-seed mixing increased by modern gin equipment. By W. W. Ballard and C. B. Doyle. United States Department of Agriculture Circular 205. Issued February 17, 1922.

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